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PFAS in electronics

We represent over 36,000 businesses across Europe

The voice of digitally transforming industries

- platform services
- data analytics
- software
- hardware
- telecoms
- semiconductors
- cloud technology

- Healthcare
- Manufacturing
- Finance
- Buildings
- Mobility

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Electronic products

- Electronic products are everywhere in today's society and so are PFAS
- … but are PFAS present everywhere in electronic products?

- Electronic products are essential for society
- … but are PFAS essential in electronic products?

- PFAS parts can be large, PFAS can be present in microscopic amounts
- Since the first call for evidence, electronic industry is investigating the use of PFAS

Examples of PFAS uses

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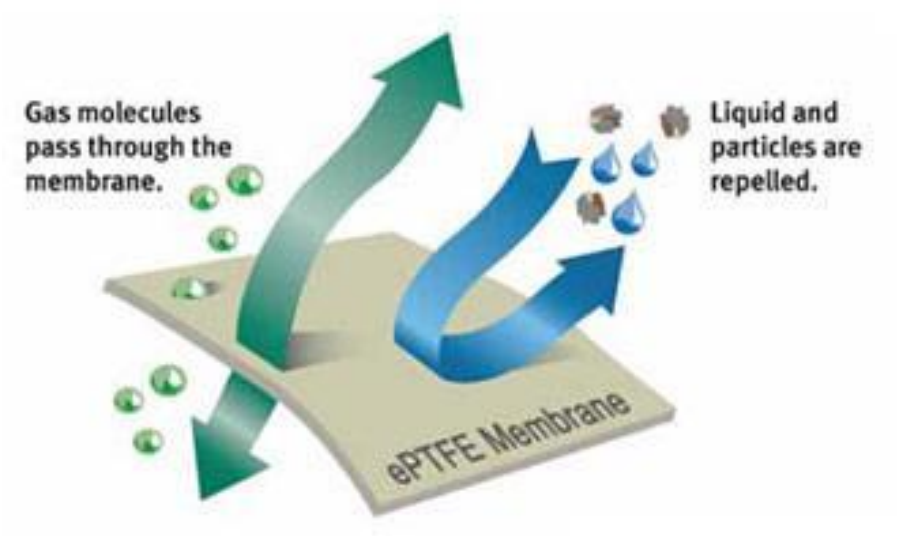
Examples of PFAS uses

- Moving parts (low friction, wear prevention)
- Semiconductors
- Coatings
- Lubricants and grease, surfactants in adhesives and inks (low friction, surface tension)
- Battery electrodes
- Capacitors (low dielectric constant)
- Wiring insulation, plastic covers (low dielectric constant, flame retardant, heat resistant)
- F-gases in refrigerating equipment
- LCD displays, printed circuit boards
- Gaskets, sealing, tubing (chemical resistance)
- Many uses in manufacturing processes (chemical resistance)

ePTFE membranes in acoustic vents



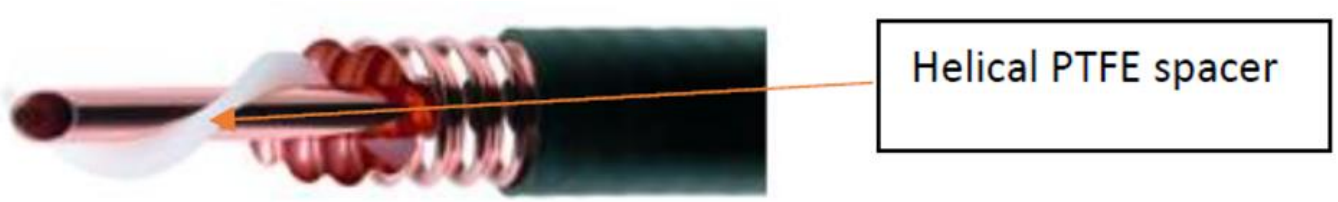
ePTFE membranes allow for the passage of gas molecules for proper air and sound flow while simultaneously keeping liquid and particles out in order to prevent deterioration and destruction of the electrical parts in a portable internal speaker or mic

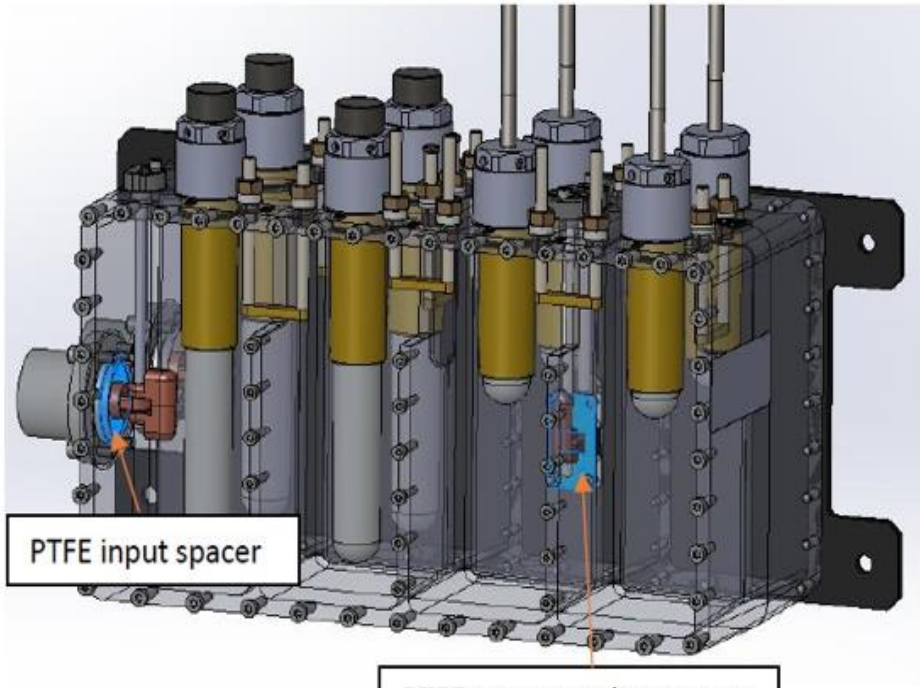
Durability and reliability are essential (ErP directive, ecodesign, emergencies)

There is no non-PFAS alternative for this application

Antennas and broadcasting

- PTFE in antennas and broadcasting equipment for its excellent mechanical and dielectric properties
- All other materials lead to shorter lifetime and higher energy losses

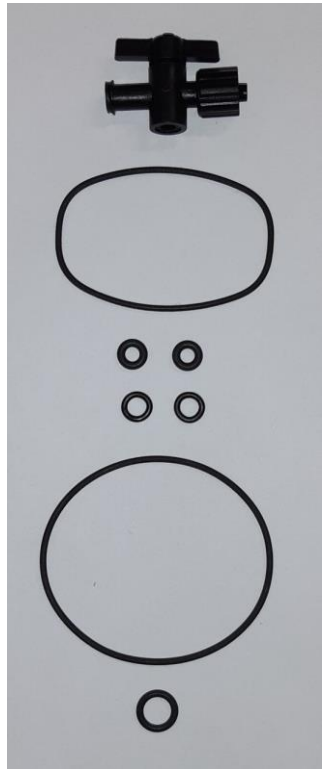




TV filter

Wide format printer

Ink handling (tubing, sealing):
Fluoropolymers and fluoroelastomers provide chemical resistance.
Alternative materials can lead to leaking

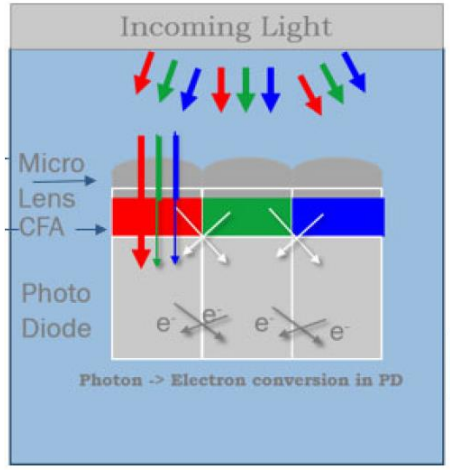


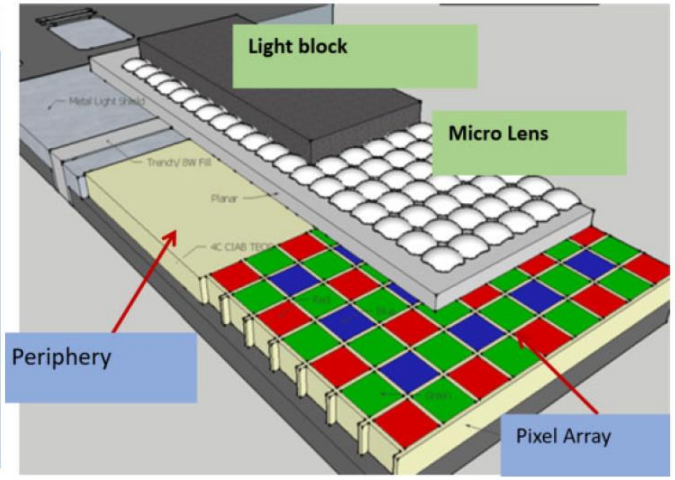
Mechanical parts may contain PTFE
It provides low friction and high durability
Alternatives often require redesign of a unit

Many of the other examples are present in printers as well

PFHxA in CMOS Image Sensor

CMOS Image Sensor has three color films (Red, Green and Blue) which are formed on the imaging semiconductor component by the photolithography process and remain on the semiconductor surface as a thin layer (0.5 to 3 microns)





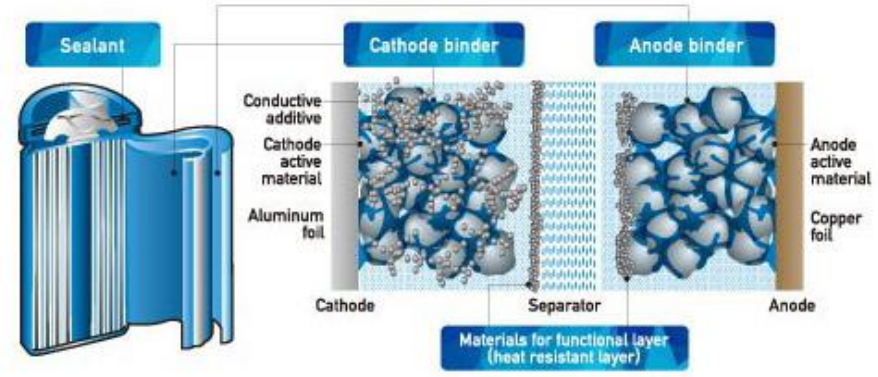
Color resists and black light block layers contain PFHxA for its specific surfactant properties

Global CMOS Image Sensor sales reached $16.6 billion in 2020 and grew 19% in 2021 to $22.8 billion

Total PFHxA in all Image Sensors globally is estimated at less than 5.5 kilograms/year

There is no non-PFAS alternative available that could be used in this application

PVDF Cathode electrode binder lithium battery



Lithium battery electrode binder bonds active material particles together (cohesion) and adheres electrode coating layer to current collector (metal foils)

Lithium battery electrode binder material needs to have the following properties:

1. Good adhesion/cohesion
2. Good electrochemical stability
3. Low swell when soaked in organic electrolyte
4. Good ionic and electron conductivity
5. Good rheology properties for manufacturing process

There is no alternative for cathode electrode binder material (for the anode an alternative has been found)

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Exposure

- PFAS in articles typically do not lead to environmental exposure during product lifetime. PFAS is solid itself and/or embedded in a solid matrix
- Electronic equipment is collected separately according to WEEE directive
- Risk is low

Alternatives

- Some applications of PFAS have been replaced in the past years
- PFAS often are the more expensive option and only used if no alternatives are available
- Extensive research specifically focused on some applications concluded there were no alternatives for PFAS possible
- Many applications do not have drop-in alternatives
  - A single material does not have all properties that PFAS have
  - Case-by case investigation and partial redesign are required

Complexity

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Complex electronic products

- Electronic products can contain >1000 individual buy-parts, often complex products themselves
- Supply chains are often global and complex
- PFAS is currently not listed SVHC → no article 33/SCIP information from supply chain
- Larger PFAS parts and parts with prescribed PFAS are known
- Smaller parts with PFAS applied upstream are often not known
- Even when FMD is available, ppb level information on PFAS will be lacking
- Obtaining information usually takes >1 year (depending on concentration level)

Transition time

- Change to PFAS-free alternatives (where possible) requires several steps
  - Identification
  - Finding and selecting an alternative
  - Implementation by manufacturer
  - Testing and certification
  - Implementation and testing in next steps in the supply chain
  - Redesign all products
- Total time can be >10 years (after alternative becomes available)

Measuring method

- Detection limit in complex electronics is much higher than in liquid samples
- Smallest article in a complex object must comply
- Sample complexity and low/unknown extraction efficiency raise detection limit

- After consultation of state-of-the art laboratories, detection limit of PFHxA in complex articles is estimated to be 150 ppm or higher

Conclusions

- Digital products are essential for our society
- PFAS are widely used in electronic products for a variety of purposes, many are essential for functioning, safety or durability
- Risk is low. Often small amounts inside a solid matrix. No exposure
- Some PFAS have already been replaced
- For many applications there is no (drop-in) alternative
- Ppb or ppm level restrictions are not manageable nor enforceable
- Industry is facing a complex task identifying PFAS and replacing where possible